COST COMPARISON · OF FIVE INSTITUTIONAL FOOD DELIVERY SYSTEMS

On January 24, 1978, four USDA agencies—Agricultural Research Service (ARS), Cooperative State Research Service (CSRS), Extension Service (ES), and the National Agricultural Library (NAL)—merged to become a new organization, the Science and Education Administration (SEA), U.S. Department of Agriculture.

This publication was prepared by the Science and Education Administration's Federal Research staff, which was formerly the Agricultural Research Service.

PREFACE

This study is part of a research program to find ways to lower food distribution costs. It was undertaken to determine the costs for several methods of delivering combined loads of frozen foods and nonrefrigerated groceries in dual-purpose trucks. It is a followup of a previous study, in which using one vehicle for frozen foods and another for groceries was more costly than using a dual-purpose vehicle equipped with movable bulkhead for shipping combined loads.

Both studies were designed by the author. The data were supplied under a single contract by James A. Mixon and Associates, Inc., Food Industry Services, Washington, D.C., and were evaluated by the author.

Special acknowledgment is due the following distributors who provided essential data and made their operations available for time studies: Baer Foods, Hagerstown, Md.; Capitol Foods, Atlanta, Ga.; Frederick Produce Company, Frederick, Md.; and Sandler Foods, Norfolk, Va.

Valuable assistance in determining equipment costs was provided by the Auto-Truck Division, United Buying Service, Washington, D.C.; Duralite Body Division, Warner Freuhauf Trailer Company, Baltimore, Md.; Thermo King Corporation, Minneapolis, Minn.; Dole Refrigeration Company, Chicago, Ill.; Linde Division, Union Carbide, Indianapolis, Ind.; and F/G Products, Inc., Rice Lake, Wis.

This study was conducted under the general supervision of Kenneth H. Brasfield, Chief, Food Distribution Research Laboratory, Agricultural Marketing Research Institute, Beltsville Agricultural Research Center.

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By James J. Karitas, *marketing specialist* [1]

ABSTRACT

In this study, costs are compared for several methods of delivering combined loads of frozen foods and groceries from local warehouses to food service establishments. Five basic systems were studied and costs were developed for a fleet of 12 vehicles with 18-foot truck bodies.

Costs were based on delivering 3,900 cases per peak day to 300 customers, with an average order of 13 cases. Frozen foods ranged from 20 to 50 percent of the truckload and groceries and some nonfrozen perishables comprised the remainder.

The basic delivery systems were (1) noninsulated, nonrefrigerated trucks with 17.5-cubic foot insulated containers, (2) noninsulated, nonrefrigerated trucks with 50-cubic foot insulated containers, (3) partly insulated, partly refrigerated trucks with fixed bulkhead, (4) fully insulated, 50-percent refrigerated trucks with movable bulkhead, and (5) fully insulated, fully refrigerated trucks with insulating blankets.

Several methods were compared based on annual ownership, operating, and labor costs. The findings were as follows:

At the 20-percent level of frozen foods, using noninsulated, nonrefrigerated trucks with 50-cubic foot insulated containers resulted in the lowest cost—$22,299 lower than the highest cost method.

At the 30-percent level, this method also produced the lowest cost—$26,864 lower than the highest cost method.

At the 40-percent level, using partly insulated, partly refrigerated trucks with fixed bulkhead resulted in the lowest cost.

At the 40- and 50-percent levels, respective costs were $11,981 and $7,273 lower than the highest cost method. At all levels, using fully insulated, fully refrigerated single-compartment trucks resulted in the highest cost.

Differences between the higher cost of movable over fixed bulkheads were $7,328 at the 30-percent, $5,183 at the 40-percent, and $2,472 at the 50-percent levels. Because of this nominal difference and the obvious flexibility of movable bulkheads, an operator may decide to use the movable bulkhead.

Regardless of the level of frozen foods, labor costs between the methods only varied about $7,363 annually, whereas ownership and operating costs combined varied about $28,475.

INTRODUCTION

In a U.S. Department of Agriculture study,[2]

using single-purpose vehicles to deliver loads of only frozen foods or only groceries to the same food service customers was more costly than using dual-purpose vehicles equipped with movable bulkhead. Cost for an institutional distributor with annual sales of $6.5 million was about $50,000 higher annually when using single-purpose vehicles.

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[2] KARITAS, J. J. COSTS OF DELIVERING GROCERIES AND FROZEN FOODS TO RESTAURANTS IN COMBINED OR SEPARATE LOADS. U.S. Dept. Agr. Mktg. Res. Rpt. 1060, 28 pp. 1977.

The study reported here was designed to determine the relative costs for several methods of shipping combined loads of frozen foods and groceries on the same delivery vehicle.

To establish a practical base for the comparisons, delivery operations were studied at four participating wholesale firms that handle both frozen and grocery products. The assumed delivery characteristics are based on adjusted averages of the data obtained from the four distributors and are as follows:

(1) A delivery volume per peak day of 3,900 cases. This is an average of 4 peak days per week out of a normal 5½-day delivery week. Deliveries on slow and moderate days, normally Mondays, Tuesdays, and Saturdays, were combined to represent 1 peak day. The delivery year was 208 peak days.

(2) Delivery service per normal peak day to 300 customers, with an average order of 13 cases.

The ratio of frozen foods to the total truckload is varied from 20 to 50 percent in this report to develop costs for each feasible delivery method at different load levels.

Costs are developed for owning and operating vehicles, including refrigeration equipment and the labor required to load, drive, unload trucks, and close down delivery trips. Costs for owning and operating vehicles were obtained from the four participating distributors and from equipment manufacturers and are based on late 1973 prices.[3]

Labor costs were determined by making time studies of various operations performed by personnel of the four participating distributors. Miles driven and time required on route were established by an observer riding in the delivery vehicle.

Some of the data collected from the four firms were used to establish a "universe" for the previous study, which compared costs for dual- and single-purpose vehicles. Since such factors as load size, average order size, truck utilization, travel time, and distance covered on route serve as a common base for both studies, some of the same data and information are used in both reports. For additional information on delivery equipment, refrigeration for delivery vehicles, and operating characteristics of the firms studied, see Marketing Research Report 1060.[4]

No attempt is made here to measure the effectiveness of the methods in protecting or maintaining product quality.

DELIVERY SYSTEM COSTS

Annual costs for ownership, operating, and labor are developed in this study for 5 basic systems, using a fleet of 12 vehicles with 18-foot truck bodies delivering combined loads of frozen foods and groceries with some nonfrozen perishables.

These systems were (1) noninsulated, nonrefrigerated trucks with 17.5-cubic foot insulated containers, (2) noninsulated, nonrefrigerated trucks with 50-cubic foot insulated containers, (3) partly insulated, partly refrigerated trucks with fixed bulkhead, (4) fully insulated, 50-percent refrigerated trucks with movable bulkhead, and (5) fully insulated, fully refrigerated trucks with insulating blankets to protect some items from low temperatures.

Of these basic systems, three were feasible at the 20-percent level of frozen foods, five at 30 percent, three at 40 percent, and three at

50 percent. Costs are presented for each feasible system at a given level of frozen foods, totaling 14 methods, and hereafter referred to as methods A–N. For instance, if costs were developed for a given system at two different levels of frozen foods, two applications of the same basic system would result. However, costs may vary because of different method requirements for containers, insulation, refrigeration, and different operating or labor costs at each level of frozen foods.

The five basic systems are illustrated in figure 1, and three types of containers used in the first two systems are shown in figure 2.

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[3] Although the data in this report were collected in 1973, the methodology is still valid and useful as a guideline for developing similar cost and input data.

[4] See footnote 2 on p. 1.
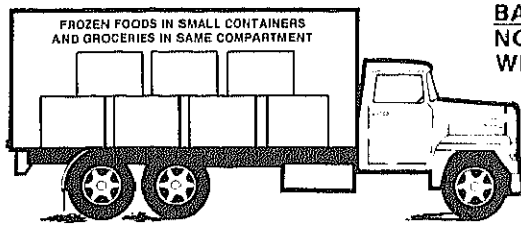
BASIC SYSTEM 1
NONINSULATED, NONREFRIGERATED TRUCK
WITH 17.5-CU FT INSULATED CONTAINERS AND DRY ICE
(USED WITH METHODS A AND D).

FROZEN FOODS IN SMALL CONTAINERS
AND GROCERIES IN SAME COMPARTMENT
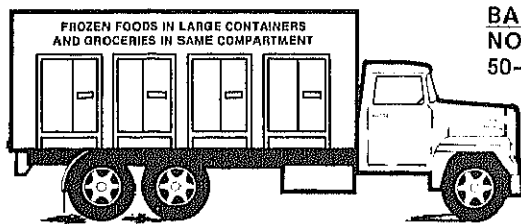
BASIC SYSTEM 2
NONINSULATED, NONREFRIGERATED TRUCK WITH
50-CU FT INSULATED CONTAINERS AND DRY ICE
(USED WITH METHODS B AND E).

FROZEN FOODS IN LARGE CONTAINERS
AND GROCERIES IN SAME COMPARTMENT
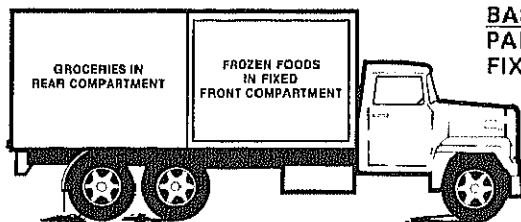
BASIC SYSTEM 3
PARTLY INSULATED, PARTLY REFRIGERATED TRUCK WITH
FIXED BULKHEAD (USED WITH METHODS H, K, AND N).

GROCERIES IN
REAR COMPARTMENT

FROZEN FOODS
IN FIXED
FRONT COMPARTMENT
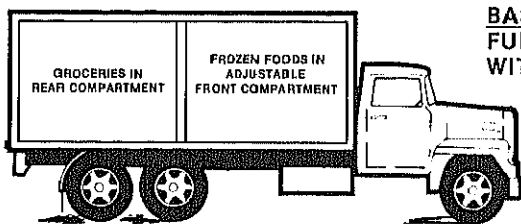
BASIC SYSTEM 4
FULLY INSULATED, 50-PERCENT REFRIGERATED TRUCK
WITH MOVABLE BULKHEAD (USED WITH METHODS C, G, J,
AND M).

GROCERIES IN
REAR COMPARTMENT

FROZEN FOODS IN
ADJUSTABLE
FRONT COMPARTMENT

BASIC SYSTEM 5
FULLY INSULATED, FULLY REFRIGERATED TRUCK WITH
INSULATING BLANKET (USED WITH METHODS F, I, AND L).

FROZEN FOODS AND GROCERIES IN SAME
COMPARTMENT

INSULATING BLANKET

FIGURE 1.—Five basic systems for shipping mixed loads of frozen foods and groceries. (Detailed refrigeration equipment not shown for systems 3–5.)
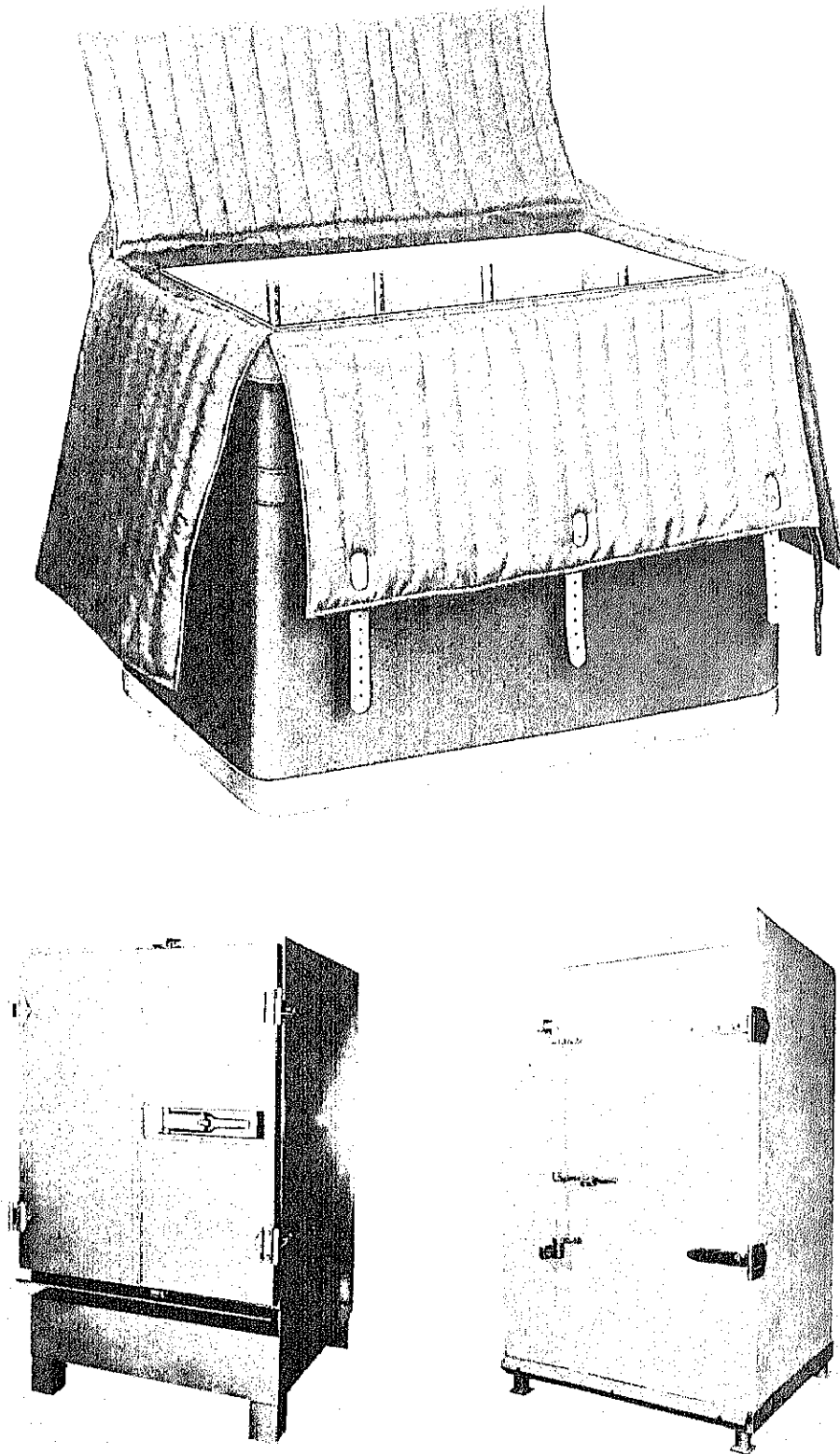
FIGURE 2.—Containers: Above, 17.5-cubic foot; below, 50-cubic foot.

Ownership Costs

Ownership costs for the systems consisted of depreciation, interest on invested capital, insurance, and licenses. These costs were based on using 18-foot truck bodies for each method with varying amounts of insulation and refrigeration and for some methods with varying numbers of insulated containers.

Ownership costs for the refrigeration were based on an average of three types commonly used for refrigerated transport—mechanical, holdover plates, and liquid nitrogen. Other kinds of refrigeration were excluded from the study to limit the number of variables, and no attempt was made to determine the adequacy of each. The refrigeration equipment was sized and operating costs were determined by the contractor.

Depreciation

The chassis and cab of the delivery vehicle were depreciated over 4 years, truck body 6 years, refrigeration equipment 5 years, 17.5-cubic foot containers 8 years, and 50-cubic foot containers 5 years. The straight-line method of depreciation was used with no residual value. The initial purchase price also included an average cost for preparing refrigerated bodies for installation of the refrigeration equipment. (For investments required for the various methods, see appendix table 18.)

Interest on Invested Capital

Interest costs were computed at an annual rate of 10 percent for one-half life expectancy and prorated over the full life.

Insurance

Insurance costs were based on new equipment with coverage for bodily injury, property damage, personal driving protection, and uninsured motorists. Coverage for damage to cargo was also included in the annual premium. Costs included a 20-percent fleet discount.

Licenses

License fees were based on 1974 charges for Maryland and on chassis weights for 6,300 pounds.

Total Ownership Costs

At the 20-percent level of frozen foods, daily ownership cost per truck for the lowest cost method (B) was $18.53 and for the highest cost method (C) $25.94 (table 1). Annual fleet ownership cost was $18,504 lower for method B. The higher cost for method C was due principally to the higher cost of the truck body because of insulation, bulkhead, and side door and the cost of the refrigeration equipment, installation, and body preparation as compared with the cost of the containers.

At the 30-percent level of frozen foods, the daily ownership cost per truck for the lowest cost method (E) was $18.92 and for the highest cost method (F) $26.11. Annual fleet ownership cost was $17,928 lower for method E. This difference was due principally to the greater amount of insulation and the refrigeration capacity for method F.

At the 40-percent level of frozen foods, the daily ownership cost per truck for the lowest cost method (K) was $23.48 and for the highest cost method (I) $26.11. Annual fleet ownership cost was $6,564 lower for method K. This difference was due principally to the greater amount of insulation and the refrigeration capacity for method I.

At the 50-percent level of frozen foods, the daily ownership cost per truck for the lowest cost method (N) was $24.07 and for the highest cost method (L) $26.11. Annual fleet ownership cost for method N was $5,076 lower. This difference again was due principally to more insulation and more refrigeration capacity for method L.

Operating Costs

Operating expense consisted of operating both the vehicles and the refrigeration equip-

TABLE 1.—*Ownership costs for several methods of shipping combined loads of frozen foods and groceries in 18-ft truck bodies at 325 cases per trip with varying load mix and equipment*

Method Load mix and equipment	Annual ownership cost per truck				Daily owner- ship cost per truck	Annual owner- ship cost per fleet of 12 trucks
	Depreciation					
	Truck body	Refrig- eration equip- ment or con- tainers	Insur- ance	Total [1]		
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
20-PERCENT FROZEN FOODS, 80-PERCENT GROCERIES						
A__Noninsulated, nonrefrigerated, with seven 17.5-cu ft insulated containers	566	253	788	3,887	18.69	46,644
B__Noninsulated, nonrefrigerated, with three 50-cu ft insulated containers	566	223	785	3,854	18.53	46,248
C__Fully insulated, 50-percent refrig- erated, with movable bulkhead	1,484	739	893	5,396	25.94	64,752
30-PERCENT FROZEN FOODS, 70-PERCENT GROCERIES						
D__Noninsulated, nonrefrigerated, with eleven 17.5-cu ft insulated containers	566	399	803	4,048	19.46	48,576
E__Noninsulated, nonrefrigerated, with four 50-cu ft insulated containers	566	297	793	3,936	18.92	47,232
F__Fully insulated, fully refrigerated, with insulating blanket	1,268	987	895	5,430	26.11	65,160
G__Fully insulated, 50-percent refrig- erated, with movable bulkhead	1,484	739	893	5,396	25.94	64,752
H__30-percent insulated, 30-percent refrigerated, with fixed bulkhead	936	717	846	4,779	22.98	57,348
40-PERCENT FROZEN FOODS, 60-PERCENT GROCERIES						
I__Fully insulated, fully refrigerated, with insulating blanket	1,268	987	895	5,430	26.11	65,160
J__Fully insulated, 50-percent refrig- erated, with movable bulkhead	1,484	739	893	5,396	25.94	64,752
K__40-percent insulated, 40-percent refrigerated, with fixed bulkhead	1,032	717	854	4,883	23.48	58,596
50-PERCENT FROZEN FOODS, 50-PERCENT GROCERIES						
L__Fully insulated, fully refrigerated, with insulating blanket	1,268	987	895	5,430	26.11	65,160
M__Fully insulated, 50-percent refrig- erated, with movable bulkhead	1,484	739	893	5,396	25.94	64,752
N__50-percent insulated, 50-percent refrigerated, with fixed bulkhead	1,125	739	863	5,007	24.07	60,084

[1] Total for each method includes $2,100 depreciation for chassis and cab and $180 for licenses.

ment and of hauling the additional weight of refrigeration equipment, insulation, bulkhead, and doors. (For detailed data, see appendix tables 19-22.)

Cost of Operating Vehicles

Vehicle operating expense was based on cost of gas, oil, and maintenance and was computed at 12.3 cents per mile and 127.63 miles per day for 208 days per year. This cost was identical for all systems at $15.70 per day.

Cost of Operating Refrigeration Equipment

Refrigeration operating cost for the methods other than those using insulated containers and dry ice represents the average operating cost for three types of refrigeration at a given mix of frozen food and groceries. The cost includes the estimated gas consumption for mechanical, the electrical consumption for holdover plate, and the nitrogen for liquid nitrogen refrigeration. The refrigeration cost is based on types capable of providing certain cooling requirements. This cost was determined by making heat gain and service load calculations to determine the amount of refrigeration required per hour and calculating the average cost for the three types of refrigeration. The cost also included estimates for repair and maintenance of the equipment. (See appendix table 21 for annual refrigeration costs by compartment length.)

Operating cost for the methods using containers is based on an assumed use of 2 pounds of dry ice in each 17.5-cubic foot container and 5 pounds in the 50-cubic foot container per trip. The containers were typically precooled in the freezer prior to loading.

Cost of Hauling Additional Weight

Each truck, in the methods studied, when loaded had increased total weight as compared with a noninsulated, nonrefrigerated, loaded grocery truck. This increase was due to the insulation, additional doors or bulkheads, average weight of the three types of refrigeration, and weight of containers and dry ice. This additional weight was assumed to increase vehicle

operating costs in direct proportion (see appendix table 19). For instance, a 10-percent increase in weight would increase mileage charges by 10 percent. If daily mileage charges were $15, a 10-percent increase would raise them to $16.50 daily.

Total Operating Costs

At the 20-percent level of frozen foods, the daily operating cost per truck for the lowest cost method (A) was $18.08 and for the highest cost method (C) $20.35 (table 2). Annual fleet operating cost was $5,666 lower for method A. Method C had a higher cost because refrigeration was higher than the dry ice used in method A and also because of hauling the refrigeration equipment, doors, and body insulation.

At the 30-percent level of frozen foods, the daily operating cost per truck for the lowest cost method (D) was $19.44 and for the highest cost method (F) $22.07. Annual fleet operating cost was $6,565 lower for method D. This difference was due to the same reasons as for method C at the 20-percent level of frozen foods.

At the 40-percent level of frozen foods, the daily operating cost per truck for the lowest cost method (K) was $19.90 and for the highest cost method (I) $22.07. Annual fleet operating cost was $5,417 lower for method K. The higher cost for method I was due to insulating and refrigerating the entire truck body as compared with methods J and K.

At the 50-percent level of frozen foods, the daily operating cost per truck for the lowest cost method (N) was $20.44 and for the highest cost method (L) $22.07. Annual fleet operating cost for method N was $4,069 lower. The higher cost for method L was due to the same reasons as for method I at the 40-percent level.

Labor Costs

Labor costs were established for loading and unloading vehicles and for closing down delivery trips by conducting time studies on location or by using controlled laboratory procedures. Each task was broken into defined work

TABLE 2.—*Operating costs for several methods of shipping combined loads of frozen foods and groceries in 18-ft truck bodies at 325 cases per trip with varying load mix and equipment*

Method Load mix and equipment	Cost per truck per day of—			Total operating costs per—		
	Hauling additional weight [1]		Operating refrig- eration equipment [2]	Truck per day [3]	Truck per year	Fleet of 12 trucks per year
	Percent	Dollars	Dollars	Dollars	Dollars	Dollars
20-PERCENT FROZEN FOODS, 80-PERCENT GROCERIES						
A__Noninsulated, nonrefrigerated, with seven 17.5-cu ft insulated containers _____	1.78	0.28	2.10	18.08	3,760.64	45,128
B__Noninsulated, nonrefrigerated, with three 50-cu ft insulated containers _____	5.93	.93	2.25	18.88	3,927.04	47,124
C__Fully insulated, 50-percent refrig- erated, with movable bulkhead ____	10.44	1.64	3.01	20.35	4,232.80	50,794
30-PERCENT FROZEN FOODS, 70-PERCENT GROCERIES						
D__Noninsulated, nonrefrigerated, with eleven 17.5-cu ft insulated containers _____	2.79	.44	3.30	19.44	4,043.52	48,522
E__Noninsulated, nonrefrigerated, with four 50-cu ft insulated containers _____	7.91	1.24	3.00	19.94	4,147.52	49,770
F__Fully insulated, fully refrigerated, with insulating blanket _____	10.70	1.68	4.69	22.07	4,590.56	55,087
G__Fully insulated, 50-percent refrig- erated, with movable bulkhead ____	10.44	1.64	3.12	20.46	4,255.68	51,068
H__30-percent insulated, 30-percent refrigerated, with fixed bulkhead__	4.88	.77	3.12	19.59	4,074.72	48,897
40-PERCENT FROZEN FOODS, 60-PERCENT GROCERIES						
I__Fully insulated, fully refrigerated, with insulating blanket _____	10.70	1.68	4.69	22.07	4,590.56	55,087
J__Fully insulated, 50-percent refrig- erated, with movable bulkhead ____	10.44	1.64	3.37	20.71	4,307.68	51,692
K__40-percent insulated, 40-percent refrigerated, with fixed bulkhead __	5.28	.83	3.37	19.90	4,139.20	49,670
50-PERCENT FROZEN FOODS, 50-PERCENT GROCERIES						
L__Fully insulated, fully refrigerated, with insulating blanket _____	10.70	1.68	4.69	22.07	4,590.56	55,087
M__Fully insulated, 50-percent refrig- erated, with movable bulkhead ___	10.44	1.64	3.77	21.11	4,390.88	52,691
N__50-percent insulated, 50-percent refrigerated, with fixed bulkhead _	6.16	.97	3.77	20.44	4,251.52	51,018

[1] Includes weight of insulation, containers, refrigeration equipment, and dry ice.

[2] Includes 2 pounds of dry ice for small containers and 5 pounds for large containers at 15 cents per pound where applicable. Equipment operating costs are based on annual costs for compartment length divided by 208 operating days per year.

[3] For each method, mileage charges, included in daily total, were $15.70 based on 127.63 miles per day times 12.3 cents per mile for gas, oil, and maintenance.

elements.[5] Time values for these elements were established by using a stopwatch. These values were then adjusted to reflect the speed of an average operator working at a normal pace and applied at the frequency of occurrence to develop the production standard. An allowance of 15 percent was made for personal time and work fatigue.

In addition, allowances were made for reasonable routine delays, such as waiting to have a delivery ticket receipted, as well as unavoidable nonroutine delays, such as unfastening a stuck door. Unreasonable delays, such as waiting an undue length of time for a c.o.d. collection, were not included as part of the standard times. Such delays often accounted for differences in actual man-hours utilized for a delivery trip and the standard times given. Actual times might also fluctuate over and below the established standard because of the varied work pace of employees, since a normal work pace was reflected in the standard times developed in this study.

The labor required to deliver orders included loading vehicles, driving, unloading at the food service establishment, and closing down delivery on return to the warehouse. Loading vehicles is often considered a warehousing rather than a delivery activity. However, loading was included as a delivery activity because it was affected by the type of delivery equipment used.

In all the methods, checking was performed by a two-man team. The orders were checked while on the platform truck and the cases were labeled with stop sequence numbers. These tasks were accomplished by one man calling and labeling the cases and another checking the invoices. Cases were stacked in the truck by one man pushing the platform truck into the vehicle and unloading it. The exception to this was for fixed bulkhead methods, where frozen foods were loaded through the side door by one man, and for the fully insulated and fully refrigerated methods, which used a two-man team and conveyors to load mixed orders. In this instance, cases were checked and labeled while on the conveyor.

In the methods using insulated containers, frozen foods were checked and labeled on the platform truck and packed into the containers; then the containers were moved into the vehicle. The 17.5-cubic foot containers were transported into the vehicle with a two-wheel handtruck and 50-cubic foot containers by an electrically powered pallet jack.

In loading combined products in vehicles equipped with a movable bulkhead, frozen foods were moved first into the front compartment and then the groceries were placed in the rear after the movable bulkhead had been positioned and secured.

One man drove each truck, unloaded the orders, and transported them into the food service establishment using a two-wheel handtruck. When he returned to the warehouse, he removed the returned items and any empty containers from the truck, parked the vehicle, and checked in his tickets and receipts at the office.

An observer riding in the delivery vehicle recorded travel times and distances and conducted time studies of individual unloading operations. Delivery routes were classified as urban, suburban, or rural. Distances and travel times were established for travel from the warehouse to the first delivery stop, travel between delivery stops, and travel from the last delivery stop to the warehouse. The miles traveled per trip were 73.1 for urban, 121.4 for suburban, and 188.4 for rural routes, with an average of 127.63 miles (appendix table 22).

An inspection of the time-study data reveals that the labor requirements [6] for the various methods at a given mix of frozen foods and groceries do not vary to a great degree (table 3). Many of the methods required similar time for such common elements as checking orders on platform trucks, making ready for departure, returning to vehicles, and parking vehicles. The element showing the most difference was truck loading with two-man loading by conveyor for methods F, I, and L when compared with the other methods at a given product mix. This was due to using a two-man team and conveyors required to dovetail cases of

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[5] For description of work elements, see appendix.

[6] For details of labor requirements, see description of work elements (appendix).

TABLE 3.—*Comparison of daily labor requirements and costs for several methods of shipping combined loads of frozen foods and groceries in 18-ft truck bodies at 325 cases per trip with varying load mix and equipment* [1]

Method	Load mix and equipment	Load orders into vehicle	Unload orders from vehicle	Close down delivery	Total Time [2]	Total Cost [3]
		Hours	*Hours*	*Hours*	*Hours*	*Dollars*
20-PERCENT FROZEN FOODS, 80-PERCENT GROCERIES						
A__	Noninsulated, nonrefrigerated, with seven 17.5-cu ft insulated containers	2.01	4.18	0.16	6.35	31.75
B__	Noninsulated, nonrefrigerated, with three 50-cu ft insulated containers	1.85	4.14	.17	6.16	30.80
C__	Fully insulated, 50-percent refrigerated, with movable bulkhead	1.68	4.34	.14	6.17	30.85
30-PERCENT FROZEN FOODS, 70-PERCENT GROCERIES						
D__	Noninsulated, nonrefrigerated, with eleven 17.5-cu ft insulated containers	2.19	4.22	.18	6.59	32.95
E__	Noninsulated, nonrefrigerated, with four 50-cu ft insulated containers	1.94	4.16	.19	6.30	31.50
F__	Fully insulated, fully refrigerated, with insulating blanket	2.35	4.10	.13	6.59	32.95
G__	Fully insulated, 50-percent refrigerated, with movable bulkhead	1.68	4.41	.14	6.24	31.20
H__	30-percent insulated, 30-percent refrigerated, with fixed bulkhead	1.87	4.41	.14	6.42	32.10
40-PERCENT FROZEN FOODS, 60-PERCENT GROCERIES						
I__	Fully insulated, fully refrigerated, with insulating blanket	2.35	4.11	.13	6.59	32.95
J__	Fully insulated, 50-percent refrigerated, with movable bulkhead	1.68	4.52	.14	6.35	31.75
K__	40-percent insulated, 40-percent refrigerated, with fixed bulkhead	1.93	4.52	.14	6.59	32.95
50-PERCENT FROZEN FOODS, 50-PERCENT GROCERIES						
L__	Fully insulated, fully refrigerated, with insulating blanket	2.35	4.11	.13	6.60	33.00
M__	Fully insulated, 50-percent refrigerated, with movable bulkhead	1.68	4.62	.14	6.44	32.20
N__	50-percent insulated, 50-percent refrigerated, with fixed bulkhead	1.99	4.62	.14	6.75	33.55

[1] Does not include average time on route. For source of data, see appendix table 5.

[2] Total time from appendix table 5, which is more precise than totaling 3 previous columns here; results vary here because of rounding.

[3] At $5 per hour.

frozen foods and groceries for the same customer in single-compartment refrigerated truck bodies. On the other hand, these three methods produced lower costs for unloading at 30-, 40-, and 50-percent frozen food levels (table 3).

When the labor requirements and costs for loading, unloading, closing down delivery, and time on route are compared for the methods used at the various load mixes, the labor cost differences were as follows:

At 20-percent frozen foods, the lowest cost method (B) was $56.75 per truck per day and the highest (A) $57.70. Annual fleet labor costs were $2,371 lower for method B (table 4).

At 30-percent frozen foods, the lowest cost method (G) was $57.15 per truck per day and

TABLE 4.—*Labor costs for several methods of shipping combined loads of frozen foods and groceries in 18-ft truck bodies at 325 cases per trip with varying load mix and equipment*

Method Load mix and equipment	Daily labor requirements			Labor costs [3] per—		
	Loading, unloading, and closing down delivery [1]	Time on route [2]	Total	Truck per day	Truck per year	Fleet of 12 trucks per year
	Hours	Hours	Hours	Dollars	Dollars	Dollars
20-PERCENT FROZEN FOODS, 80-PERCENT GROCERIES						
A__Noninsulated, nonrefrigerated, with seven 17.5-cu ft insulated containers _____	6.35	5.19	11.54	57.70	12,001.60	144,019
B__Noninsulated, nonrefrigerated, with three 50-cu ft insulated containers _____	6.16	5.19	11.35	56.75	11,804.00	141,648
C__Fully insulated, 50-percent refrigerated, with movable bulkhead ___	6.17	5.19	11.36	56.80	11,814.40	141,773
30-PERCENT FROZEN FOODS, 70-PERCENT GROCERIES						
D__Noninsulated, nonrefrigerated, with eleven 17.5-cu ft insulated containers _____	6.59	5.19	11.78	58.90	12,251.20	147,014
E__Noninsulated, nonrefrigerated, with four 50-cu ft insulated containers _____	6.30	5.19	11.49	57.45	11,949.60	143,395
F__Fully insulated, fully refrigerated, with insulating blanket _____	6.59	5.19	11.78	58.90	12,251.20	147,014
G__Fully insulated, 50-percent refrigerated, with movable bulkhead ___	6.24	5.19	11.43	57.15	11,887.20	142,646
H__30-percent insulated, 30-percent refrigerated, with fixed bulkhead _	6.42	5.19	11.61	58.05	12,074.40	144,893
40-PERCENT FROZEN FOODS, 60-PERCENT GROCERIES						
I__Fully insulated, fully refrigerated, with insulating blanket _____	6.59	5.19	11.78	58.90	12,251.20	147,014
J__Fully insulated, 50-percent refrigerated, with movable bulkhead ___	6.35	5.19	11.54	57.70	12,001.60	144,019
K__40-percent insulated, 40-percent refrigerated, with fixed bulkhead _	6.59	5.19	11.78	58.90	12,251.20	147,014
50-PERCENT FROZEN FOODS, 50-PERCENT GROCERIES						
L__Fully insulated, fully refrigerated, with insulating blanket _____	6.60	5.19	11.79	58.95	12,261.60	147,139
M__Fully insulated, 50-percent refrigerated, with movable bulkhead ___	6.44	5.19	11.63	58.15	12,095.20	145,142
N__50-percent insulated, 50-percent refrigerated, with fixed bulkhead _	6.75	5.19	11.94	59.70	12,417.60	149,011

[1] From appendix table 5.

[2] From appendix table 22.

[3] At $5 per hour and 208 days per year.

the highest (D and F) $58.90. Annual fleet labor costs were $4,368 lower for method G.

At 40-percent frozen foods, the lowest cost method (J) was $57.70 per truck per day and the highest (I and K) $58.90. Annual fleet

labor costs were $2,995 lower for method J.

At 50-percent frozen foods, the lowest cost method (M) was $58.15 per truck per day and the highest (N) $59.70. Annual fleet labor costs were $3,869 lower for method M.

TOTAL COSTS

Total annual fleet ownership, operating, and labor costs for the various shipping methods are shown in figure 3.

At 20-percent frozen foods, method B with large containers had the lowest annual cost at $235,020. However, method A with smaller containers was only slightly higher at $235,791. The most expensive at this level was method C with movable bulkhead at $257,319. The annual range from lowest to highest was $22,299.

At 30-percent frozen foods, method E with large containers had the lowest annual cost at $240,397. Method D with smaller containers was only slightly higher at $244,112. The annual range from lowest to highest, which was method F with insulating blanket, was $26,864.

At 40-percent frozen foods, method K with

fixed bulkhead had the lowest annual cost at $255,280. The annual range from lowest to highest, which was method I with insulating blanket, was $11,981.

At 50-percent frozen foods, method N with fixed bulkhead had the lowest annual cost at $260,113. The annual range from lowest to highest, which was method L with insulating blanket, was $7,273.

An examination of the components of total costs indicates that differences in ownership and operating costs between the methods are of greater significance than differences in labor costs (fig. 3). Regardless of the level of frozen foods, labor costs for the methods only varied about $7,363 annually, whereas ownership and operation costs combined varied about $28,475.

A. NONINSULATED, NONREFRIGERATED, WITH SEVEN 17.5-CU FT INSULATED CONTAINERS
B. NONINSULATED, NONREFRIGERATED, WITH THREE 50-CU FT INSULATED CONTAINERS
C. FULLY INSULATED, 50-PERCENT REFRIGERATED, WITH MOVABLE BULKHEAD

D. NONINSULATED, NONREFRIGERATED, WITH ELEVEN 17.5-CU FT INSULATED CONTAINERS
E. NONINSULATED, NONREFRIGERATED, WITH FOUR 50-CU FT INSULATED CONTAINERS
F. FULLY INSULATED, FULLY REFRIGERATED, WITH INSULATING BLANKET
G. FULLY INSULATED, 50-PERCENT REFRIGERATED, WITH MOVABLE BULKHEAD
H. 30-PERCENT INSULATED, 30-PERCENT REGRIGERATED, WITH FIXED BULKHEAD

I. FULLY INSULATED, FULLY REFRIGERATED, WITH INSULATING BLANKET
J. FULLY INSULATED, 50-PERCENT REFRIGERATED, WITH MOVABLE BULKHEAD
K. 40-PERCENT INSULATED, 40-PERCENT REFRIGERATED, WITH FIXED BULKHEAD

L. FULLY INSULATED, FULLY REFRIGERATED, WITH INSULATING BLANKET
M. FULLY INSULATED, 50-PERCENT REFRIGERATED, WITH MOVABLE BULKHEAD
N. 50-PERCENT INSULATED, 50-PERCENT REFRIGERATED, WITH FIXED BULKHEAD

20-PERCENT FROZEN FOODS, 80-PERCENT GROCERIES

	Ownership	Operating	Labor	Total
A	46,644	45,128	144,019	235,791
B	46,248	47,124	141,648	235,020
C	64,752	50,794	141,773	257,319

30-PERCENT FROZEN FOODS, 70-PERCENT GROCERIES

	Ownership	Operating	Labor	Total
D	48,576	48,522	147,014	244,112
E	47,232	49,770	143,395	240,397
F	65,160	55,087	147,014	267,261
G	64,752	51,068	142,646	258,466
H	57,348	48,897	144,893	251,138

40-PERCENT FROZEN FOODS, 60-PERCENT GROCERIES

	Ownership	Operating	Labor	Total
I	65,160	55,087	147,014	267,261
J	64,752	51,692	144,019	260,463
K	58,596	49,670	147,014	255,280

50-PERCENT FROZEN FOODS, 50-PERCENT GROCERIES

	Ownership	Operating	Labor	Total
L	65,160	55,087	147,139	267,386
M	64,752	52,691	145,142	262,585
N	60,084	51,018	149,011	260,113

0　25　50　75　100　125　150　175　200　225　250　275

THOUSANDS OF DOLLARS

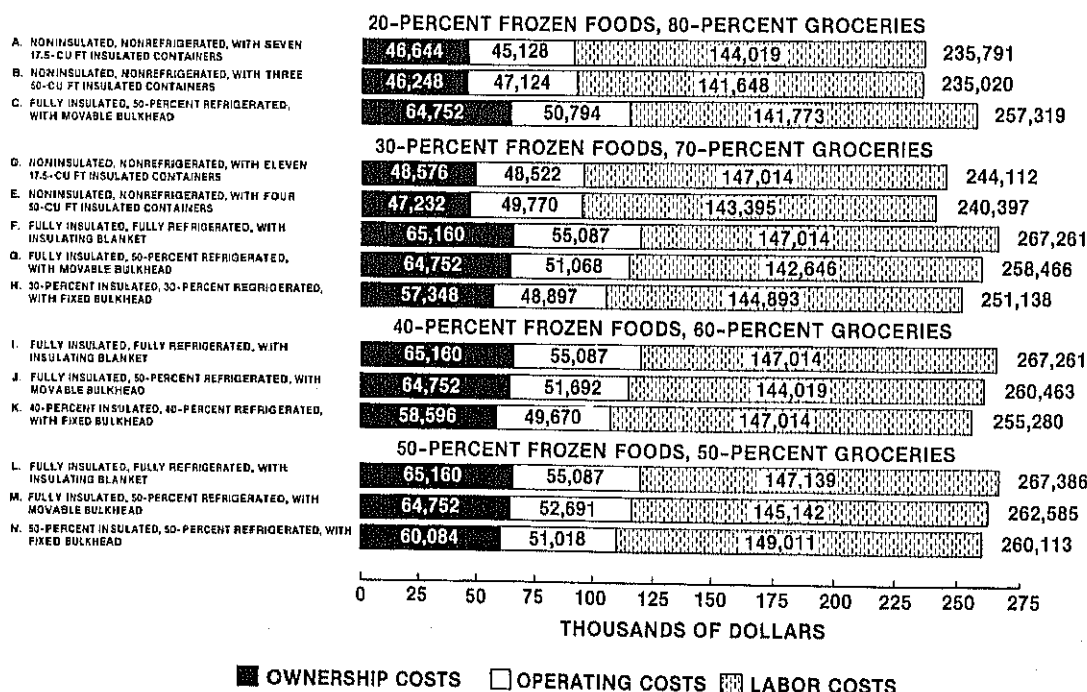■ OWNERSHIP COSTS　☐ OPERATING COSTS　▦ LABOR COSTS

FIGURE 3.—Total annual fleet ownership, operating, and labor costs for several methods of shipping combined loads of frozen foods and groceries in 18-foot truck bodies at 325 cases per trip with varying load mix and equipment.

DISCUSSION

The data in this report indicate that, at the lower levels of frozen foods, methods A, B, D, and E using insulated containers produced the lowest overall costs. At the 20-percent level, either size container resulted in about the same cost. At 30-percent, the large container produced $3,715 less cost annually than the small container. Fully insulated and fully refrigerated trucks produced the highest costs at the frozen food levels studied. The movable bulkhead method C at the 20-percent level annually cost $22,299 more than method B with the large container.

The movable bulkhead methods G, J, and M also produced higher costs than the fixed bulkhead methods H, K, and N at the 30-, 40-, and 50-percent levels. The annual differences were about $7,328, $5,183, and $2,472, respectively. However, considering the flexibility of the truck with movable bulkhead as well as the ease of loading, an operator would probably choose the truck with the movable rather than the fixed bulkhead.

Costs for the fixed bulkhead method were not included at the 20-percent frozen food level because it would have resulted in a permanent compartment of only 3.6 lineal feet, which was not considered practical. The fully refrigerated method, as in F, I, and L, was not included at the 20-percent level because obviously it was more costly.

Costs for the small and large insulated containers were not included at the 40- and 50-percent frozen food levels because the large number of containers, relative to the size of the truck body, would probably preclude efficient truck loading and unloading, especially for the typical small orders handled by institutional distributors.

The data reported here indicate the relative costs of the various methods studied. The type of equipment selected by an operator will depend on the nature of his trading territory, size of orders, number of stops, and other factors, such as the possibility of backhauling. Although some operators who serve primarily urban areas may standardize on one particular size and type of delivery equipment, others who cover greater geographical areas may use larger vehicles. Still others may find that using a mix of body sizes and types is advantageous. An operator utilizing a truck with movable bulkhead may also elect not to install the bulkhead and perhaps use insulated containers on a given route when shipping only a few cases of frozen foods in a truckload and thus save on refrigeration costs.

APPENDIX

Description of Work Elements in Delivering Orders to Food Service Establishments [1]

A. Load Orders Into Vehicle:

105—*Make ready to load vehicle.*—Starts when checkers or loaders move from shipping with stack of tickets for delivery run. Includes assembling loading crew, setup or other make-ready for loading, and assembling shipping containers. Ends when preparations are completed and crew turns to check and/or load.

110—*Check orders on platform truck.*—Starts when checker completes preparation and turns to begin check. Includes positioning platform trucks and verifying and labeling cases with stop numbers. Ends when checking and labeling of one platform truck are completed and checker turns to other tasks.

111—*Load orders from platform truck through rear door.*—Starts when loading crew completes preparation for loading and turns to load vehicle. Includes moving warehouse platform truck into vehicle, offloading merchandise, stacking merchandise in vehicle, and returning equipment to platform. Ends when all orders are stacked in vehicle and worker turns to other tasks.

112—*Load orders from platform truck through side door.*—Starts when loading crew completes preparation for loading and turns to load vehicle. Includes moving warehouse platform truck to side door of vehicle, carrying merchandise into vehicle, and returning platform truck to stow area. Ends when all orders are stacked in truck and worker turns to other tasks.

113—*Check and load mixed orders using conveyor.*—Starts when loading crew, including caller-checker, completes preparation for loading and turns to load vehicle. Includes calling and verifying orders, loading cases onto conveyor, labeling cases with stop numbers, and stacking merchandise in vehicle. Ends when all orders are stacked in vehicle and crew turns to other tasks.

114—*Pack orders into insulated container.*—Starts when worker turns to obtain insulated container. Includes positioning container near platform truck of orders, which have been checked and labeled. Ends when container is packed with merchandise and dry ice, flaps are closed, container is tagged with route designation and set aside, and worker turns to other tasks.

115—*Load insulated container into vehicle.*—Starts when worker turns to obtain handtruck. Includes bringing handtruck to container, lifting container, and transporting 30 feet into vehicle. Ends when container is positioned in vehicle and worker returns to platform, places handtruck aside, and turns to other tasks.

118—*Dry ice to insulated container.*—Starts when worker turns to obtain dry ice for packing station. Includes obtaining carry box, walking 35 feet to dry-ice container, cutting dry ice, and returning to station with supply. Ends when worker places dry ice in insulated container and places carry box aside per container. Time is based on one-way walking distance of 35 feet.

119—*Spread insulating blanket.*—Starts when worker turns to obtain insulating blanket. Includes walking 35 feet to blanket stow area and returning with blanket. Ends when worker spreads blanket over cases in vehicle to be protected and turns to other tasks. Time is expressed per trip and is based on one-way walking distance of 35 feet.

120—*Repark vehicle for side loading.*—Starts when worker moves toward vehicle. Includes reparking vehicle and opening side door. Ends when vehicle is repositioned and worker turns to other tasks.

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[1] Elements under A–C are used in tables 5–17 and elements under D in table 22.

121—*Position and secure bulkhead.*—Starts when worker reaches for movable bulkhead in vehicle and ends when worker positions and fixes bulkhead up or down and turns to other tasks.

125—*Make ready for vehicle departure.*—Starts when loading of vehicle is completed and crew turns to secure load and vehicle. Includes placing handtruck in vehicle, closing truck doors, consolidating delivery tickets and manifest, and receiving instructions. Ends when driver enters cab of vehicle and turns to depart.

130—*Unavoidable delay.*—See text.

B. Unload Orders From Vehicle:

315—*Make ready to unload vehicle.*—Starts when driver completes parking vehicle, scans order sheet, and turns to depart cab. Includes opening rear door of vehicle, stepping or climbing into vehicle, moving handtruck to tailgate, and checking delivery tickets. Ends when driver completes preparation task and turns to begin unloading.

320—*Move cases from stack to rear door.*—Starts when driver completes preparation for unloading and reaches for cases of merchandise. Ends when driver moves all cases in an order from stack to door of vehicle and turns to other tasks.

321—*Move cases from container to rear door.*—Starts when worker moves to open container. Ends when worker removes all products for an order from container, moves them to tailgate of truck, closes container, and turns to other tasks.

324—*Make ready to unload from side door.*—Starts when worker turns toward side door of vehicle. Includes dismounting from rear of truck and opening side door. Ends when worker climbs into vehicle and turns to unload.

325—*Move cases from stack to side door.*—Starts when driver completes preparation for unloading and reaches for cases of merchandise. Ends when driver moves all cases in an order from stack to door of vehicle, dismounts, and turns to other tasks.

326—*Transport cases into establishment.*—Starts when driver reaches for handtruck. Includes loading merchandise onto handtruck, closing doors of vehicle when last case is re-moved, moving merchandise to establishment, opening doors of building, positioning load in establishment, returning to vehicle for additional loads, and closing and securing doors of vehicle when last case is removed. Ends when all cases are positioned and driver turns to other tasks. Time is expressed per order and is based on one-way walking distance of 75 feet.

330—*Check order and receipt.*—Starts when deliveryman reaches for delivery ticket to check order with customer's receiving clerk. Includes waiting, counting, and calling identification of merchandise. Ends when entire order is checked, clerk signs and removes copy of delivery ticket, and deliveryman turns to other tasks.

335 — *Stow merchandise.* — Starts when driver reaches for merchandise to place on shelves or on stacks in storage room(s). Includes stacking rotating stock, rearranging, and positioning cases and ends when merchandise is stowed and deliveryman turns to other tasks.

340—*Collect c.o.d. order.*—Starts when deliveryman moves to cashier for collection of c.o.d. order. Includes waiting for payment and ends when money or check is received and pocketed and deliveryman turns to depart.

345—*Return to vehicle.*—Starts when driver completes delivery of merchandise and moves toward vehicle with handtruck. Includes opening and closing doors of establishment and ends when driver arrives at vehicle and turns to other tasks.

350—*Make ready for departure.*—Starts when deliveryman moves to prepare vehicle for departure. Includes placing handtruck in vehicle, restacking merchandise, and closing vehicle doors. Ends when driver returns to truck cab, checks delivery tickets for next destination, and turns to start motor of vehicle.

C. Close Down Delivery:

410—*Close down.*—Starts when driver turns off ignition key at warehouse platform and turns to dismount. Includes removing returns and empties from vehicle and stowing. Ends when worker completes putting vehicle in order, closes door, and turns to other tasks.

420—*Park vehicle.*—Starts when driver moves to reboard vehicle cab. Includes starting

motor and moving vehicle to parking area. Ends when driver turns off ignition, locks vehicle, and returns to warehouse.

425—Check in at warehouse.—Starts when driver arrives at warehouse office to check in ticket, manifests, c.o.d.'s, etc. Ends when check-in duties are completed, tickets, moneys, etc., are delivered to others, and driver turns to other tasks.

D. Travel on Route:

500—Travel from warehouse to first delivery stop.—Starts when driver reaches for ignition switch to depart warehouse. Includes driving to first delivery stop and ends when driver parks vehicle and turns to unload.

503—Travel between delivery stops.—Starts when driver reaches for ignition switch to depart delivery stop. Includes driving to next delivery stop and ends when driver arrives at destination, parks truck, and turns to unload.

505—Travel from last delivery stop to warehouse.—Starts when driver reaches for ignition switch to depart last delivery stop. Includes driving to warehouse and ends when driver parks vehicle and turns to dismount.

TABLE 7.—*Time required to load and deliver 25 orders of 325 cases consisting of 20-percent frozen foods and 80-percent groceries, packed in three 50-cu ft insulated containers, using a single-compartment truck body (method B)*[1]

Work element No. and description (1)	Occurrences per trip (2)	Normal time per occurrence (3)	Employees (4)	Standard time per occurrence[2] (5)	Standard time per trip[3] (6)	Elapsed time[4] (7)
	Number	*Man-minutes*	*Number*	*Man-minutes*	*Man-minutes*	*Minutes*
A. Load orders into vehicle:						
105—Make ready to load vehicle[5]	1	4.02	1	4.62	4.62	4.62
110—Check orders on platform truck[5]	325	.11	2	.13	42.25	[6]SI
111—Load orders from platform truck through rear door[3]	260	.10	1	.12	31.20	31.20
114—Pack orders into insulated container	65	.18	1	.21	13.65	13.65
115—Load insulated container into vehicle	3	.42	1	.48	1.44	1.44
118—Dry ice to insulated container	3	.88	1	1.01	3.03	3.03
125—Make ready for vehicle departure	1	4.32	1	4.97	4.97	4.97
130—Unavoidable delay – 10 percent	---	---	---	---	10.12	5.89
Total	---	---	---	---	111.28 min	64.80 min
					1.85 h	1.08 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	260	.13	1	.15	39.00	39.00
321—Move cases from container to rear door	65	.16	1	.18	11.70	11.70
326—Transport cases into establishment	25	2.50	1	2.88	72.00	72.00
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	1.40	1	1.61	9.66	9.66
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent	---	---	---	---	32.39	32.39
Total	---	---	---	---	248.30 min	248.30 min
					4.14 h	4.14 h
C. Close down delivery:						
410—Close down	1	2.60	1	2.99	2.99	2.99
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent	---	---	---	---	.47	.47
Total	---	---	---	---	9.92 min	9.92 min
					.17 h	.16 h
Grand total (A, B, and C)	---	---	---	---	369.50 min	323.02 min
					6.16 h	5.38 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.
[3] Based on col. 2 × col. 5.
[4] Based on col. 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[6] Since checking is performed simultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 8.—*Time required to load and deliver 25 orders of 325 cases consisting of 20-percent frozen foods and 80-percent groceries, using a dual-compartment truck body with movable bulkhead (method C)*[1]

Work element No. and description	Occurrences per trip	Normal time per occurrence	Employees	Standard time per occurrence[2]	Standard time per trip[3]	Elapsed time[4]
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Number	Man-minutes	Number	Man-minutes	Man-minutes	Minutes
A. Load orders into vehicle:						
105—Make ready to load vehicle	1	3.07	1	3.53	3.53	3.53
110—Check orders on platform truck[5]	325	.11	2	.13	42.25	°SI
111—Load orders from platform truck through rear door[5]	325	.10	1	.12	39.00	39.00
121—Position and secure bulkhead	2	.90	1	1.04	2.08	2.08
125—Make ready for vehicle departure	1	4.32	1	4.97	4.97	4.97
130—Unavoidable delay – 10 percent					9.18	4.96
Total					101.01 min / 1.68 h	54.54 min / .91 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	260	.12	1	.14	36.40	36.40
324—Make ready to unload from side door	12	.55	1	.63	7.56	7.56
325—Move cases from stack to side door	65	.11	1	.13	8.45	8.45
326—Transport cases into establishment	25	2.82	1	3.24	81.00	81.00
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	1.40	1	1.61	9.66	9.66
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent					33.99	33.99
Total					260.61 min / 4.34 h	260.61 min / 4.34 h
C. Close down delivery:						
410—Close down	1	1.37	1	1.58	1.58	1.58
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent					.40	.40
Total					8.44 min / .14 h	8.44 min / .14 h
Grand total (A, B, and C)					370.06 min / 6.17 h	323.59 min / 5.39 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.
[3] Based on col. 2 × col. 5.
[4] Based on col. 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[6] Since checking is performed simultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 9.—*Time required to load and deliver 25 orders of 325 cases consisting of 30-percent frozen foods and 70-percent groceries, packed in eleven 17.5-cu ft insulated containers, using a single-compartment truck body (method D)*[1]

Work element No. and description (1)	Occurrences per trip (2) Number	Normal time per occurrence (3) Man-minutes	Employees (4) Number	Standard time per occurrence[2] (5) Man-minutes	Standard time per trip[3] (6) Man-minutes	Elapsed time[4] (7) Minutes
A. Load orders into vehicle:						
105—Make ready to load vehicle	1	5.55	1	6.38	6.38	6.38
110—Check orders on platform truck[5]	325	.11	2	.13	42.25	[6]SI
111—Load orders from platform truck through rear door[5]	228	.10	1	.12	27.36	27.36
114—Pack orders into insulated container	97	.21	1	.24	23.28	23.28
115—Load insulated container into vehicle	11	.39	1	.45	4.29	4.29
118—Dry ice to insulated container	11	.88	1	1.01	11.11	11.11
125—Make ready for vehicle departure	1	4.32	1	4.97	4.97	4.97
130—Unavoidable delay – 10 percent	---	---	---	---	11.96	7.74
Total	---	---	---	---	131.60 min / 2.19 h	85.13 min / 1.42 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	228	.13	1	.15	34.20	34.20
321—Move cases from container to rear door	97	.18	1	.21	20.37	20.37
326—Transport cases into establishment	25	2.50	1	2.88	72.00	72.00
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	1.43	1	1.64	9.84	9.84
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent	---	---	---	---	32.99	32.99
Total	---	---	---	---	252.95 min / 4.22 h	252.95 min / 4.22 h
C. Close down delivery:						
410—Close down	1	3.30	1	3.79	3.79	3.79
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent	---	---	---	---	.51	.51
Total	---	---	---	---	10.76 min / .18 h	10.76 min / .18 h
Grand total (A, B, and C)	---	---	---	---	395.31 min / 6.59 h	348.84 min / 5.81 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.
[3] Based on col. 2 × col. 5.
[4] Based on col. 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[6] Since checking is performed simultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 10.—*Time required to load and deliver 25 orders of 325 cases consisting of 30-percent frozen foods and 70-percent groceries, packed in four 50-cu ft insulated containers, using a single-compartment truck body (method E)*[1]

Work element No. and description (1)	Occurrences per trip (2)	Normal time per occurrence (3)	Employees (4)	Standard time per occurrence[2] (5)	Standard time per trip[3] (6)	Elapsed time[4] (7)
	Number	Man-minutes	Number	Man-minutes	Man-minutes	Minutes
A. Load orders into vehicle:						
105—Make ready to load vehicle[5]	1	4.33	1	4.98	4.98	4.98
110—Check orders on platform truck[5]	325	.11	2	.13	42.25	[6]SI
111—Load orders from platform truck through rear door[5]	228	.10	1	.12	27.36	27.36
114—Pack orders into insulated container	98	.18	1	.21	20.58	20.58
115—Load insulated container into vehicle	4	.42	1	.48	1.93	1.93
118—Dry ice to insulated container	4	.88	1	1.01	4.04	4.04
125—Make ready for vehicle departure	1	4.32	1	4.97	4.97	4.97
130—Unavoidable delay – 10 percent	---	---	---	---	10.61	6.39
Total	---	---	---	---	116.72 min / 1.94 h	70.25 min / 1.17 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	228	.13	1	.15	34.20	34.20
321—Move cases from container to rear door	97	.16	1	.18	17.55	17.55
326—Transport cases into establishment	25	2.50	1	2.87	72.00	72.00
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	1.43	1	1.64	9.84	9.84
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent	---	---	---	---	32.57	32.57
Total	---	---	---	---	249.71 min / 4.16 h	249.71 min / 4.16 h
C. Close down delivery:						
410—Close down	1	3.74	1	4.30	4.30	4.30
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent	---	---	---	---	.54	.54
Total	---	---	---	---	11.30 min / .19 h	11.30 min / .19 h
Grand total (A, B, and C)	---	---	---	---	377.73 min / 6.30 h	331.26 min / 5.52 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.
[3] Based on col. 2 × col. 5.
[4] Based on col. 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[6] Since checking is perform... ...ultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 11.—*Time required to load and deliver 25 orders of 325 cases consisting of 50-percent frozen foods and 50-percent groceries, using a single-compartment refrigerated truck body with insulating blanket to protect certain items from freezing (methods F, I, and L)*[1]

Work element No. and description (1)	Occurrences per trip (2)	Normal time per occurrence (3)	Employees (4)	Standard time per occurrence[2] (5)	Standard time per trip[3] (6)	Elapsed time[4] (7)
	Number	Man-minutes	Number	Man-minutes	Man-minutes	Minutes
A. Load orders into vehicle:						
105—Make ready to load	1	4.16	1	4.78	4.78	4.78
113—Check and load mixed orders using conveyor	325	.31	4	.36	117.00	29.25
119—Spread insulating blanket	1	.66	1	.76	.76	.76
125—Make ready for vehicle departure	1	4.89	1	5.62	5.62	5.62
130—Unavoidable delay – 10 percent	--	--	--	--	12.82	4.04
Total	--	--	--	--	140.98 min	44.45 min
					2.35 h	.74 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	325	.13	1	.15	48.75	48.75
326—Transport cases into establishment	25	2.50	1	2.88	72.00	72.00
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	[5]1.49	1	1.71	10.26	10.26
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent	--	--	--	--	32.18	32.18
Total	--	--	--	--	246.74 min	246.74 min
					4.11 h	4.11 h
C. Close down delivery:						
410—Close down vehicle	1	1.05	1	1.21	1.21	1.21
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent	--	--	--	--	.38	.38
Total	--	--	--	--	8.05 min	8.05 min
					.13 h	.13 h
Grand total (A, B, and C)	--	--	--	--	395.77 min	299.24 min
					6.60 h	4.99 h

[1] Does not include travel on route. Time for unloading varies among methods F, I, and L because element 335 varies with amount of frozen food.

[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.

[3] Based on col. 2 × col. 5.

[4] Based on col. 6 ÷ col. 4.

[5] Stow merchandise varies for methods F, I, and L and this time is adjusted in summary table 5.

TABLE 12.—*Time required to load and deliver 25 orders of 325 cases consisting of 30-percent frozen foods and 70-percent groceries, using a dual-compartment truck body with movable bulkhead (method G)*[1]

Work element No. and description (1)	Occurrences per trip (2)	Normal time per occurrence (3)	Employees (4)	Standard time per occurrence[2] (5)	Standard time per trip[3] (6)	Elapsed time[4] (7)
	Number	Man-minutes	Number	Man-minutes	Man-minutes	Minutes
A. Load orders into vehicle:						
105—Make ready to load vehicle	1	3.07	1	3.53	3.53	3.53
110—Check orders on platform truck[5]	325	.11	2	.13	42.25	ᵃSI
111—Load orders from platform truck through rear door[5]	325	.10	1	.12	39.00	39.00
121—Position and secure bulkhead	2	.90	1	1.04	2.08	2.08
125—Make ready for vehicle departure	1	4.32	1	4.97	4.97	4.97
130—Unavoidable delay – 10 percent					9.18	4.96
Total					101.01 min	54.54 min
					1.68 h	.91 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	227	.12	1	.14	31.78	31.78
324—Make ready to unload from side door	18	.55	1	.63	11.34	11.34
325—Move cases from stack to side door	98	.11	1	.13	12.74	12.74
326—Transport cases into establishment	25	2.82	1	3.24	81.00	81.00
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	1.43	1	1.64	9.84	9.84
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent					34.54	34.54
Total					264.79 min	264.79 min
					4.41 h	4.41 h
C. Close down delivery:						
410—Close down	1	1.37	1	1.58	1.58	1.58
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent					.40	.40
Total					8.44 min	8.44 min
					.14 h	.14 h
Grand total (A, B, and C)					374.24 min	327.77 min
					6.24 h	5.46 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.
[3] Based on col. 2 × col. 5.
[4] Based on col. 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[a] Since checking is performed simultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 13.—*Time required to load and deliver 25 orders of 325 cases consisting of 30-percent frozen foods and 70-percent groceries, using a dual-compartment truck body with fixed bulkhead (method H)*[1]

Work element No. and description (1)	Occurrences per trip (2)	Normal time per occurrence (3)	Employees (4)	Standard time per occurrence[2] (5)	Standard time per trip[3] (6)	Elapsed time[4] (7)
	Number	Man-minutes	Number	Man-minutes	Man-minutes	Minutes
A. Load orders into vehicle:						
105—Make ready to load vehicle[5]	1	3.07	1	3.53	3.53	3.53
110—Check orders on platform truck[5]	325	.11	2	.13	42.25	[6]SI
111—Load orders from platform truck through rear door[5]	227	1.10	1	.12	27.24	27.24
112—Load orders from platform truck through side door	98	.19	1	.22	21.56	21.56
120—Repark vehicle for side loading	1	1.19	1	1.37	1.37	1.37
125—Make ready for vehicle departure	1	5.21	1	5.99	5.99	5.99
130—Unavoidable delay – 10 percent	---	---	---	---	10.19	5.97
Total	---	---	---	---	112.13 min / 1.87 h	65.66 min / 1.09 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	227	.12	1	.14	31.78	31.78
324—Make ready to unload from side door	18	.55	1	.63	11.34	11.34
325—Move cases from stack to side door	98	.11	1	.13	12.74	12.74
326—Transport cases into establishment	25	2.82	1	3.24	81.00	81.00
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	1.43	1	1.64	9.84	9.84
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent	---	---	---	---	34.54	34.54
Total	---	---	---	---	264.79 min / 4.41 h	264.79 min / 4.41 h
C. Close down delivery:						
410—Close down	1	1.37	1	1.58	1.58	1.58
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent	---	---	---	---	.40	.40
Total	---	---	---	---	8.44 min / .14 h	8.44 min / .14 h
Grand total (A, B, and C)	---	---	---	---	385.36 min / 6.42 h	338.89 min / 5.65 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.
[3] Based on col. 2 × col. 5.
[4] Based on col. 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[6] Since checking is performed simultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 14.—*Time required to load and deliver 25 orders of 325 cases consisting of 40-percent frozen foods and 60-percent groceries, using a dual-compartment truck body with movable bulkhead (method J)*[1]

Work element No. and description (1)	Occurrences per trip (2)	Normal time per occurrence (3)	Employees (4)	Standard time per occurrence[2] (5)	Standard time per trip[3] (6)	Elapsed time[4] (7)
	Number	Man-minutes	Number	Man-minutes	Man-minutes	Minutes
A. Load orders into vehicle:						
105—Make ready to load vehicle	1	3.07	1	3.53	3.53	3.53
110—Check orders on platform truck[5]	325	.11	2	.13	42.25	[6]SI
111—Load orders from platform truck through rear door[5]	325	.10	1	.12	39.00	39.00
121—Position and secure bulkhead	2	.90	1	1.04	2.08	2.08
125—Make ready for vehicle departure	1	4.32	1	4.97	4.97	4.97
130—Unavoidable delay – 10 percent	---	---	---	---	9.18	4.96
Total	---	---	---	---	101.01 min / 1.68 h	54.54 min / .91 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	195	.12	1	.14	27.30	27.30
324—Make ready to unload from side door	20	.55	1	.63	12.60	12.60
325—Move cases from stack to side door	130	.11	1	.13	16.90	16.90
326—Transport cases into establishment	25	2.97	1	3.42	85.50	85.50
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	1.46	1	1.68	10.08	10.08
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent	---	---	---	---	35.39	35.39
Total	---	---	---	---	271.32 min / 4.52 h	271.32 min / 4.52 h
C. Close down delivery:						
410—Close down	1	1.37	1	1.58	1.58	1.58
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent	---	---	---	---	.40	.40
Total	---	---	---	---	8.44 min / .14 h	8.44 min / .14 h
Grand total (A, B, and C)	---	---	---	---	380.77 min / 6.35 h	334.30 min / 5.57 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col 3 × 1.15 = col. 5.
[3] Based on col 2 × col. 5.
[4] Based on col 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[6] Since checking is performed simultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 15.—*Time required to load and deliver 25 orders of 325 cases consisting of 40-percent frozen foods and 60-percent groceries, using a dual-compartment truck body with fixed bullhead (method K)*[1]

Work element No. and description (1)	Occurrences per trip (2)	Normal time per occurrence (3)	Employees (4)	Standard time per occurrence[2] (5)	Standard time per trip[3] (6)	Elapsed time[4] (7)
	Number	*Man-minutes*	*Number*	*Man-minutes*	*Man-minutes*	*Minutes*
A. Load orders into vehicle:						
105—Make ready to load vehicle	1	3.07	1	3.53	3.53	3.53
110—Check orders on platform truck[5]	325	.11	2	.13	42.25	[a]SI
111—Load orders from platform truck through rear door[5]	195	.10	1	.12	23.40	23.40
112—Load orders from platform truck through side door	130	.19	1	.22	28.60	28.60
120—Repark vehicle for side loading	1	1.19	1	1.37	1.37	1.37
125—Make ready for vehicle departure	1	5.21	1	5.99	5.99	5.99
130—Unavoidable delay – 10 percent	---	---	---	---	10.51	6.29
Total	---	---	---	---	115.65 min	69.18 min
					1.93 h	1.15 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	195	.12	1	.14	27.30	27.30
324—Make ready to unload from side door	20	.55	1	.63	12.60	12.60
325—Move cases from stack to side door	130	.11	1	.13	16.90	16.90
326—Transport cases into establishment	25	2.97	1	3.42	85.50	85.50
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	1.46	1	1.68	10.08	10.08
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent	---	---	---	---	35.39	35.39
Total	---	---	---	---	271.32 min	271.32 min
					4.52 h	4.52 h
C. Close down delivery:						
410—Close down	1	1.37	1	1.58	1.58	1.58
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent	---	---	---	---	.40	.40
Total	---	---	---	---	8.44 min	8.44 min
					.14 h	.14 h
Grand total (A, B, and C)	---	---	---	---	395.41 min	348.94 min
					6.59 h	5.82 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.
[3] Based on col. 2 × col. 5.
[4] Based on col. 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[a] Since checking is performed simultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 16.—*Time required to load and deliver 25 orders of 325 cases consisting of 50-percent frozen foods and 50-percent groceries, using a dual-compartment truck body with movable bulkhead (method M)*[1]

Work element No. and description (1)	Occurrences per trip (2)	Normal time per occurrence (3)	Employees (4)	Standard time per occurrence[2] (5)	Standard time per trip[3] (6)	Elapsed time[4] (7)
	Number	*Man-minutes*	*Number*	*Man-minutes*	*Man-minutes*	*Minutes*
A. Load orders into vehicle:						
105—Make ready to load vehicle[5]	1	3.07	1	3.53	3.53	3.53
110—Check orders on platform truck[5]	325	.11	2	.13	42.25	°SI
111—Load orders from platform truck through rear door[5]	325	.10	1	.12	39.00	39.00
121—Position and secure bulkhead	2	.90	1	1.04	2.08	2.08
125—Make ready for vehicle departure	1	4.32	1	4.97	4.97	4.97
130—Unavoidable delay – 10 percent	---	---	---	---	9.18	4.96
Total	---	---	---	---	101.01 min / 1.68 h	54.54 min / .91 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	163	.12	1	.14	22.82	22.82
324—Make ready to unload from side door	22	.55	1	.63	13.86	13.86
325—Move cases from stack to side door	162	.11	1	.13	21.06	21.06
326—Transport cases into establishment	25	3.11	1	3.58	89.50	89.50
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
335—Stow merchandise	6	1.49	1	1.71	10.26	10.26
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
180—Unavoidable delay – 15 percent	---	---	---	---	36.16	36.16
Total	---	---	---	---	277.21 min / 4.62 h	277.21 min / 4.62 h
C. Close down delivery:						
410—Close down	1	1.37	1	1.58	1.58	1.58
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent	---	---	---	---	.40	.40
Total	---	---	---	---	8.44 min / .14 h	8.44 min / .14 h
Grand total (A, B, and C)	---	---	---	---	386.66 min / 6.44 h	340.19 min / 5.67 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.
[3] Based on col. 2 × col. 5.
[4] Based on col. 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[6] Since checking is performed simultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 17.—*Time required to load and deliver 25 orders of 325 cases consisting of 50-percent frozen foods and 50-percent groceries, using a dual-compartment truck body with fixed bulkhead (method N)* [1]

Work element No. and description (1)	Occurrences per trip (2)	Normal time per occurrence (3)	Employees (4)	Standard time per occurrence [2] (5)	Standard time per trip [3] (6)	Elapsed time [4] (7)
	Number	Man-minutes	Number	Man-minutes	Man-minutes	Minutes
A. Load orders into vehicle:						
105—Make ready to load vehicle	1	3.07	1	3.53	3.53	3.53
110—Check orders on platform truck [b]	325	.11	2	.13	42.25	[c] SI
111—Load orders from platform truck through rear door	163	.10	1	.12	19.56	19.56
112—Load orders from platform truck through side door	162	.19	1	.22	35.64	35.64
120—Repark vehicle for side loading	1	1.19	1	1.37	1.37	1.37
125—Make ready for vehicle departure	1	5.21	1	5.99	5.99	5.99
130—Unavoidable delay – 10 percent	---	---	---	---	10.85	6.61
Total	---	---	---	---	119.19 min / 1.99 h	72.70 min / 1.21 h
B. Unload orders from vehicle:						
315—Make ready to unload vehicle	25	.73	1	.84	21.00	21.00
320—Move cases from stack to rear door	163	.12	1	.14	22.82	22.82
324—Make ready to unload from side door	22	.55	1	.63	13.86	13.86
325—Move cases from stack to side door	162	.11	1	.13	21.06	21.06
326—Transport cases into establishment	25	3.11	1	3.58	89.50	89.50
330—Check order and receipt	25	1.11	1	1.28	32.00	32.00
385—Stow merchandise	6	1.49	1	1.71	10.26	10.26
340—Collect c.o.d. order	5	1.27	1	1.46	7.30	7.30
345—Return to vehicle	25	.41	1	.47	11.75	11.75
350—Make ready for departure	25	.40	1	.46	11.50	11.50
130—Unavoidable delay – 15 percent	---	---	---	---	36.16	36.16
Total	---	---	---	---	277.21 min / 4.62 h	277.21 min / 4.62 h
C. Close down delivery:						
410—Close down	1	1.37	1	1.58	1.58	1.58
420—Park vehicle	1	1.70	1	1.96	1.96	1.96
425—Check in at warehouse	1	3.91	1	4.50	4.50	4.50
130—Unavoidable delay – 5 percent	---	---	---	---	.40	.40
Total	---	---	---	---	8.44 min / .14 h	8.44 min / .14 h
Grand total (A, B, and C)	---	---	---	---	404.84 min / 6.75 h	356.35 min / 5.97 h

[1] Does not include travel on route.
[2] Includes 15-percent personal and fatigue factor; col. 3 × 1.15 = col. 5.
[3] Based on col. 2 × col. 5.
[4] Based on col. 6 ÷ col. 4.
[5] Based on 70+ cases per platform truck.
[6] Since checking is performed simultaneously (SI) with other load elements, no additional elapsed time is charged for element 110.

TABLE 18.—*Investment required for selected types of delivery equipment for mixed loads of frozen foods and groceries*

Equipment for 18-ft truck bodies	Load mix				Investment for chassis and cab	Investment for truck body				Investment for containers or refrigerated equipment[3]	Total
	Frozen foods		Groceries			Uninsulated	Insulated[1]	Total	Adjustment[2]		
	Percent	Cases	Percent	Cases							
	Percent	*Cases*	*Percent*	*Cases*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
Uninsulated with—											
Seven 17.5-cu ft containers	20	65	80	260	7,000	2,129	---	2,129	2,614	1,449	11,063
Three 50-cu ft containers	20	65	80	260	7,000	2,129	---	2,129	2,614	1,272	10,886
Eleven 17.5-cu ft containers	30	98	70	227	7,000	2,129	---	2,129	2,614	2,277	11,891
Four 50-cu ft containers	30	98	70	227	7,000	2,129	---	2,129	2,614	1,696	11,310
Fully insulated, fully refrigerated, with one 9- by 14-ft insulating blanket[4]	50	162	50	163	7,000	---	5,243	5,243	5,853	4,067	16,920
Fully insulated, 50-percent refrigerated, with movable bulkhead	30	98	70	227	7,000	---	6,206	---	6,854	2,957	16,811
	40	130	60	195	7,000	---	6,206	---	6,854	2,957	16,811
	50	162	50	163	7,000	---	6,206	---	6,854	2,957	16,811
50-percent insulated, 50-percent refrigerated, with fixed bulkhead	30	98	70	227	7,000	1,350	3,258	4,608	5,192	2,957	15,149
40-percent insulated, 40-percent refrigerated, with fixed bulkhead	40	130	60	195	7,000	1,650	2,543	4,193	4,761	2,867	14,628
30-percent insulated, 30-percent refrigerated, with fixed bulkhead	50	162	50	163	7,000	1,740	2,026	3,766	4,317	2,867	14,184

[1] Includes cost of insulation and preparation for refrigeration equipment where needed.
[2] Based on total cost plus 4-percent sales tax, $200 for delivery or pickup, and $200 for contingencies.
[3] Based on average investment cost for mechanical, holdover plates, and liquid nitrogen refrigeration.
[4] 9- by 14-ft blanket cost $120 plus refrigeration equipment at $3,947 equals $4,067.

TABLE 19.—Extra weight of several types of loaded delivery vehicles due to refrigeration requirements

			Weight of uninsulated truck body or compartment							Weight of refrigerated single- and dual-compartment trucks				
	Chassis weight	Truck body weight	Insulated containers[1]		Load[2]		Total			Insulated body or compartment	Refrigeration equipment[3]	Total[4]	Increase[5]	
Truck body type and size							Without containers	With containers	Increase					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Pounds	Pounds	Number	Pounds	Cases	Pounds	Pounds	Pounds	Percent	Pounds	Pounds	Pounds	Pounds	Percent
Single compartment, 18-ft body	6,300	2,800												
Dual compartment, fixed bulkhead, 18-ft body, with amount of frozen foods:			7-S	364	325	11,375	20,475	20,839	1.78	3,798	1,193	22,666	2,191	10.70
			11-S	572				21,047	2.79					
			3-L	1,215				21,690	5.93					
			4-L	1,620				22,095	7.91					
50 percent	6,300	1,395			325	11,375	19,070		---	[6]1,749	917	21,736	1,261	6.16
40 percent		1,705					19,380		---	[6]1,327	850	21,557	1,082	5.28
30 percent		1,938					19,613		---	[6]1,011	850	21,474	999	4.88
Movable bulkhead, 18-ft body, with 50-, 40-, 30-, or 20-percent frozen foods	6,300	---	---	---	325	11,375	17,675	-----	---	[6]4,020	917	22,612	2,137	10.44

[1] S = small (17.5 cu ft) at 50 pounds each plus 2 pounds of dry ice; L = large (50 cu ft) at 400 pounds each plus 5 pounds of dry ice.

[2] At 35 pounds per case.

[3] Based on average weight of mechanical, holdover plate, and liquid nitrogen refrigeration (appendix table 20).

[4] Sum of cols. 2, 7, 11, and 12 for single-compartment and 2, 3, 7, 11, and 12 for dual-compartment trucks.

[5] Col. 13 minus 20,475 pounds (col. 8).

[6] Includes weight of bulkhead and doors.

TABLE 20.—*Average weight of 3 types of refrigeration for various sizes of truck bodies or compartments*

Length of truck body or compart-ment (feet)	Mechanical refrigera-tion	Holdover refrigeration				Liquid nitrogen refrig-eration [2]	Total	Average
		Condenser and other parts	Plates [1]		Total			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Pounds	*Pounds*	*Number*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
4 _____	700	280	3	920	1,200	650	2,550	850
5 _____	700	280	3	920	1,200	650	2,550	850
6 _____	700	280	3	920	1,200	650	2,550	850
7 _____	700	280	4	920	1,200	650	2,550	850
8 _____	700	280	4	1,120	1,400	650	2,750	917
9 _____	700	280	4	1,120	1,400	650	2,750	917
10 _____	700	280	4	1,120	1,400	650	2,750	917
12 _____	700	280	4	1,120	1,400	650	2,750	917
14 _____	1,000	280	4	1,120	1,400	650	3,050	1,017
16 _____	1,000	320	5	1,360	1,680	650	3,330	1,110
18 _____	1,100	360	6	1,470	1,830	650	3,580	1,193
20 _____	1,100	360	6	1,580	1,940	650	3,690	1,230

[1] Weight of plates includes eutectic solution.
[2] Nitrogen tanks about ½ full.

TABLE 21.—*Average estimated annual operating cost per vehicle for mechanical, holdover plate, and liquid nitrogen refrigeration for truck bodies or compartments*

Length of truck body or compart-ment (feet)	Refriger-ation require-ments	Annual average cost for 3 types of refrigera-tion [1]
	Btu per hour	*Dollars*
4 _____	2,028	626
5 _____	2,535	650
6 _____	3,042	675
7 _____	3,549	701
8 _____	4,056	755
9 _____	4,563	784
10 _____	5,070	813
12 _____	6,084	857
14 _____	7,098	886
16 _____	8,112	955
18 _____	9,126	976
20 _____	10,140	1,013

[1] Based on operating 2,000 h per year.